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following: "The Formation in the Animal Body of *l*- $\beta$ -Oxybutyric Acid by the Reduction of Aceto-acetic Acid," by H. D. Dakin. Experiments are described which show that the liver possesses a mechanism, dependent upon the antagonistic action of two ferments, by which the mutual interconversion of  $\beta$ -oxybutyric acid and aceto-acetic acid may be effected. It is thought probable that the  $\beta$ -oxybutyric acid which appears in the blood in acidosis is the result of reduction of aceto-acetic acid in the liver. The mechanism of the reactions involved is discussed. "On Decomposition of Aceto-acetic Acid by Enzymes of the Liver: Part II.," by A. J. Wake-man and H. D. Dakin. The primary product of the action of the enzyme in the liver which has been shown to decompose aceto-acetic acid is *l*- $\alpha$ -rotatory  $\beta$ -oxybutyric acid. "The Products Resulting from the Putrefaction of Fibrin by *Clostridium carnofætidus*, *Salus* and *Rauschbrand*," by Francis H. McCrudden. Analyses show that distinct differences exist between the putrefactive products of the organisms named which may be of diagnostic value. "The Metabolism of Some Purine Compounds in the Dog, Pig and Man," by Lafayette B. Mendel and John F. Lyman. A comprehensive, comparative study of the fate of various purines in the organism. "A Study of Enzymes by Means of Synthetical Polypeptids," by A. H. Koelker. Racemic alanyl-glycin may advantageously be used in the study of proteolytic enzymes. The rate and extent of digestion can be easily estimated by the optical method.

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#### SPECIAL ARTICLES

##### FURTHER DATA ON THE HOMING SENSE OF NODDY AND SOOTY TERNS

DURING May and June of the present year I continued my studies on distant orientation in the noddy and sooty terns at the Tortugas colony. The report of the work done in 1907 will be found in publication 103 of the Carnegie Institution. The work in 1910 like that in 1907 was done under the auspices of the Marine Biological Laboratory of the Carnegie

Institution. I wish to thank Dr. Mayer, of the laboratory, for his continued kindness to me during the past season's work.

The 1910 season was one very unfavorable for conducting experiments upon distant orientation. The spring was late in the northern temperate regions, and this, combined with the severe storms in the Gulf, seriously handicapped the work. It was often impossible to get birds to Key West in time to make connections with the Mallory steamers. The water between Tortugas and Key West is often very rough, and unless there happens to be a flat calm we never attempt to go to Key West in our small launches. Several times our experiments had to be given up for this reason, even after the birds had been captured and marked. Then, too, after every important release (Galveston, New York and Mobile) adverse winds set in against the birds.

By far the most serious defect in the work was the failure until towards the very last to perfect a favorable technique for shipping and feeding the birds. In 1907 the orientation work was incidental. In 1910 it was the principal feature. For this reason it was desired to make large shipments. The method adopted in all cases was to capture and mark about twelve to fourteen birds, put them into one large hooded cage and give them in charge of a capable employee of the laboratory, who would accompany them on the trip and release them at the proper time. Minnows, when they could be obtained, were purchased in Key West and put in the ice chest of the Mallory boat. At times when they were not obtainable, large fish were carried and cut up into small pieces and fed the birds in the place of minnows. This latter method is not nearly so satisfactory, since many of the birds will refuse chopped fish when they will not refuse minnows. The most serious mistake made was in sending too many birds in one cage. They could not be given individual attention. Many died on the way, either from starvation or else were trampled to death. The birds apparently have an instinctive tendency to perch. Some get seriously lacerated through having others climb up and perch upon them. In carrying

birds back with me for presentation to the Bronx Zoological Park, I found that they could easily be transported if the large cage were subdivided into small individual compartments. Each bird could be taken out and fed and if it refused to eat could be forced to eat. In carrying out further experiments, this latter method alone will be adopted. If minnows can not be obtained in Key West for the trip, the experiment will be abandoned. Individual compartments and a good supply of minnows will insure the healthy arrival of a group of birds in New York, Galveston or Mobile. Birds were conveyed to all these places during the months of May and June, but the above technique was not adopted and none reached these ports in good condition. The details of these releases will follow.

*Flight from Key West.*—On May 18, twelve noddies, twelve sooties and four man-of-war birds were sent to Key West. It was originally intended to ship them to Galveston, but connection was not made with the Galveston boat. Accordingly all these birds were released in Key West harbor, 65½ miles due east of Bird Key. The weather was stormy. They were released at 2.30 P.M. All twelve of the noddies returned, but the time varied from 17½ hours to 2 days, 15 hours. Ten of the twelve sooties returned. Three returned in 17½ hours, approximately. Two required one day, 20½ hours, while the others required five, six, eight, nine and eleven days, respectively. Thus twenty-two out of twenty-four birds returned, but the time was long. I am inclined to think that the longer time required for the sooties was due to the fact that their nesting neighbors would not allow them to approach the nest (on account of the markings). The flight is interesting in showing that the retention of nest locality and nest mate is still perfect at the end of eleven days. It is of further interest in showing such a large percentage of returns. Two of the four man-of-war birds returned, but the time can not be accurately stated. One was first seen at the end of seven days, the other somewhat later. Since the man-of-war bird does not nest on the

island it is only by accident that a marked bird can be singled out of the group of five hundred which roost there.

*The Release in New York Harbor and en Route.*—On the night of May 20 (10.30 P.M.) the Mallory boat *Concha* left Key West carrying two lots of birds in charge of Mr. Wilson. One lot was to be released at an intermediate distance between Key West and New York and at night. The other lot was to be released in New York harbor. The first lot contained four sooties. They were released at 7.30 P.M., 365 miles from Bird Key. One bird returned at the end of four days. A second one returned at the end of about five weeks (Mr. Wilson noted the return of this bird after I left the island. He may have made some mistake in noting the bird. It is better to look upon this return as only probable). The second lot of birds containing five noddies and six sooties were released in New York harbor at 4.30 P.M. in a fog. Since no minnows were obtained for this long trip, the birds were in very poor condition. All of the birds flew about two hundred yards out from the ship and alighted upon the water. This they never, or rarely, do, naturally. In their weakened condition I doubt if any ever arose from the water. None returned to Bird Key. Even had the birds been able to fly back into milder waters (where they could have obtained food probably for the first time) they would have had to contend against adverse winds.

*Galveston and en Route.*—Two lots were sent out. The first to be released about 500 miles out, the second in Galveston harbor. The birds were captured May 29. They were sent in the laboratory launch *Physalia* to Key West on May 30. They left (Mr. Wilson in charge) in the Mallory boat *Concha* at twelve noon June 1. The first lot of birds containing three noddies—two having died in passage—and four sooties were released Friday, June 3, at 4.45 A.M. in the open waters of the gulf. The *Concha* was then 470 knots from Key West. Bird Key is 60 knots to west of Key West. This distance has to be subtracted, leaving 410 knots, or approximately 460 miles. (The birds had really traveled nearly

600 miles). Two of the three noddies returned at the end of three days against heavy winds. None of the four sooties returned, which is to be expected since my experiments show that the sooty can not spend the night on the water and remain in good condition. This return of the two weakened noddies over water is to my mind the most wonderful flight on record. There is neither a stick nor a stone which might serve as a visual landmark between Bird Key and Galveston.

Several of the original lot of both noddies and sooties died on the way to Galveston. Six noddies and five sooties survived. They were released on Saturday, the fourth, at 5 A.M. They were very weak and flew a short way to the shore and alighted there. None of these birds returned to Bird Key. Mr. Wilson remained in Galveston until the following Wednesday, June 8. On the homeward trip he noticed one marked sooty resting on a piece of driftwood, approximately 400 miles out from Galveston. The red marking of the bird was plainly seen with the naked eye and was still more clearly seen with the aid of the field glass. The sooty is uncommon in those waters and Mr. Wilson has been familiar with the noddy and sooty terns for years. I think his observation is wholly reliable. That this bird should have reached this distance on the homeward route is remarkable. The distance from Galveston to Bird Key is approximately 800 miles. Since the sooty in all probability can not remain in the water over night, and since it is improbable that floating driftwood can always be found when the bird is fatigued, the failure of these birds to return over the open water for 800 miles is not to be wondered at. Adverse winds were again in evidence upon this trip.

*The Release at Mobile.*—Seven noddies and seven sooties were sent to Mobile on June 4 in charge of Captain Lumblum. For some reason the birds did not thrive and five out of the fourteen died in passage. The others were in poor condition. The birds were hardly more than released before a heavy head wind set in, which culminated in a storm so severe that all hope was given up of their

return. None returned within the limits of my stay.

As a net result of my work then on the homing sense, we have a failure of returns from New York, Galveston and Mobile; we have one sure return, and another probable one from a night release off the northern coast of Florida, 362 miles from Bird Key; we have two noddies out of three returning from a distance of 460 miles over open water in three days against an adverse wind; and a probable partial return of one sooty from Galveston. However, we gained the needed experience in crating and in caring for the birds which will insure a successful continuation of the work at some later time.

*Experiments to Determine the Rapidity of Flight.*—Three noddies and one sooty used in the above flight from Key West were again captured and sent to Key West (65½ miles away). They were captured on the night of June 16 and released at 1.25 in Key West, June 17. They returned to Bird Key that same afternoon, together, at 5.45. They returned just as the other birds were coming in from the feeding grounds. They probably stopped to feed as soon as familiar waters were reached.

*Experiments to Test Cyon's Hypothesis of Special Nasal Sense.*—Cyon's hypothesis to the effect that pigeons utilize a special nasal sense in homing is too well known to require discussion.

Three noddies were captured on the evening of June 16 and confined in small cages until daylight of the following morning. At daylight I closed the anterior nares of these birds tightly with wax and then coated the surface heavily with asphaltum, tying the legs of the birds for several hours until the asphaltum hardened. Two of the birds I sent to Key West in a hooded cage by the laboratory launch. The control bird was kept until the launch was due in Key West. It was then carried to Loggerhead Key, some three or four miles distant and released. It returned immediately to its nest and resumed its normal activities.

The other birds were released in Key West

harbor at 1.25 P.M.. Both were on their nests at daylight of the following morning. In all probability they returned in the evening of the previous day (that is, on the same day they were released). I recaptured these birds and found that the nares were still perfectly closed. The asphaltum had not been even scratched. Both birds were in splendid condition.

*Experiments to Test the Water Habits of Terns.*—In my previous report I made the statement that the terns are never seen in the water, unless they fall in by accident. I made no experimental test in 1907 of their conduct when forced to remain in the water. It is especially desirable in homing experiments to know whether these birds can rest on the water over night and still fly up from it in the morning. For example, the flight of 800 miles from Galveston to Bird Key can not be made in a day, and unless the bird can rest on the water at night they must perish. Exhaustive tests were made by placing a large wire cage in the water and confining the birds therein. I quote an experiment in detail.

Two noddies and two sooties were placed in the cage at 5.15 P.M. All the birds alighted on the surface of the water and then flew up and struck against the sides of the cage. Both noddies and sooties swam easily. The noddies seemed very much at home in the water. Their swimming movements were graceful and well coordinated. When alighting upon the surface of the water they folded their wings tightly against the body and held the breast and tail feathers high above the surface of the water.

The sooties on the other hand, arose and alighted clumsily. They kept their head and tail barely out of the water. Sometimes, indeed, the wings were stretched out in a very awkward way. In about two hours the birds became quiet, and ceased to fly against the sides of the cage. The noddies made just as vigorous efforts to get out as did the sooties. It soon became too dark to distinguish the birds and I then left them undisturbed until 8.30 in the morning of the following day. At that time *both noddies* were in *first class condition*, and were swimming as easily as

when first placed in the water. I opened the cage and both birds swam out and arose from the water.

*One sooty was dead.* The other was just *barely alive*. The feathers of this bird were all water-soaked. It was shivering with cold. It could neither swim nor fly. I carried the bird to the shore and put it in the sun, where it remained motionless for nearly two hours, and then flew away. I have repeated these experiments again and again and always with essentially the same results. I then modified the experiment slightly by tying small wooden floats ( $\frac{1}{8}$  inch thick and 6 inches square) in such a way that they remained in the center of the cage, regardless of the tide. Under these conditions the birds, both noddies and sooties immediately utilized the floats, and remained resting upon them making few efforts to escape. Even the sooties are in perfect condition after a night spent in this way.

It seems well established by these experiments that the noddy can spend a whole night in the water and be little the worse for it, but that the sooty must perish unless floating driftwood or other objects afford it a resting place.

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#### A NEW AWNLESS BARLEY

A NEW and distinct type of awnless winter barley has been developed by the Office of Grain Investigations of the Department of Agriculture. It differs from the beardless barley now cultivated in that there is no appendage on the glume. This variety is a selection from among a large number of hybrids produced from a cross between Tennessee Winter, a white six-rowed variety (*Hordeum vulgare*), and Black Arabian, a black two-rowed variety (*Hordeum distichum*). In the third generation a peculiar form appeared in which the median spikelets contained awns from three to four inches long, while a few of the lateral spikelets contained rudimentary grains with short awns. These short-awned rudimentary grains were planted separately in